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NEW JERSEY

DEPARTMENT OF ENVIRONMENTAL PROTECTION

OFFICE OF COASTAL ZONE MANAGEMENT

OCEAN RESOURCES: PHYSICAL

A Staff Working Paper

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November, 1976

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Note: This staff working paper is one of a series of Issue and Policy Alternative Papers presenting facts, analyses, and conceptual policy alternatives on coastal resources and coastal land and water uses. The purpose of this draft document is to stimulate discussion and comments that will assist preparation of the management program for the New Jersey coastal zone.

This report was prepared in part with financial assistance from the National Oceanic and Atmospheric Administration under the federal Coastal Zone Management Act, P.L. 92-583.

Comments, criticism, additions, and suggestions are welcome and should be addressed to the New Jersey Office of Coastal Zone Management.

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INTRODUCTION

Physical marine resources are those physical features, exclusive of mineral deposits, which by their presence in the marine environment significantly contribute to the marine ecology, commercial and recreational activities, and economy of coastal New Jersey. The range of these resources include: inlets and beaches, submarine rock outcrops, ship wrecks and artificial fishing reefs, jetties, sand ridges and basins, and submarine canyons.

The ocean floor off New Jersey, for the most part, is rather uniform in character. The nearshore marine environment, consisting of the ocean waters within New Jersey territorial seas, is characterized by gently undulating sand ridge and swale topography. The ridges are submarine sand dunes which are separated by clay lined depressions. These bathymetric features, along with other physical features of human and natural origin, act as congregation points for migratory fishes and shellfish habitat. It is the loss or degradation of these resources, including water quality, which is the main environmental problem.

This paper is intended to further debate on important marine resource issues. These first sections briefly define those issues in the coastal area and then present alternative policies which could be part of the coastal zone management program in New Jersey.

Section III describes physical characteristics of New Jersey's ocean waters. Each physical ocean resource is described along with its human and ecological values.

Section IV briefly analyzes problems presently affecting the viability and utilization of physical ocean resources.

Two appendices conclude the paper. First, tables and figures are presented. The final appendix lists reference sources.

I. ISSUE

Physical ocean resources such as inlets and beaches, submarine rock outcrops, ship wrecks, jetties, sand ridges and basins, and submarine canyons, are very important to coastal recreational activities, commercial fishing and marine ecology. These coastal resources are presently facing multiple problems and potential developmental pressures.

Present problems are both environmental and legal. Environmental problems include: ocean water quality degradation and contamination resulting from ocean disposal of sewage sludge, dredge spoils, urban runoff, municipal sewage outfalls, and toxic industrial chemicals. Legal problems relating to physical marine resources are public access to jetties and beaches.

Potential developmental pressures on physical ocean resources originate from energy facilities. These include: outer continental shelf oil and gas facilities, offshore oil ports, and floating nuclear generating power plants.

The question is, can physical ocean resources be maintained in their generally productive state, in the light of ever increasing utilization and ocean water quality degradation?

II. POLICY ALTERNATIVES

The utilization, conservation, and protection of physical marine resources located within the three mile territorial limit could be addressed by the following policies:

1. Elimination of all forms of ocean disposal of sewage sludge, dredge spoils, industrial waste acids and radioactive wastes (especially in the present dump site known as the "Dead Sea"). This might be accomplished by use of alternate disposal methods such as pyrolzsis, spray irrigation, or recycling into usable fertilizer. Substantial funds are needed for planning and construction of such facilities.
2. Use of alternate ocean disposal sites further offshore during the interim period of wastewater treatment facilities construction. The U.S. Environmental Protection Agency (EPA) has investigated this question and proposed a northern and southern alternate dump sites. The northern area appears to be more suitable, not supporting valuable surf clams as does the southern site.
3. Elimination of municipal sewage outfalls along New Jersey's coastline. This could be accomplished by construction of tertiary water treatment facilities in conjunction with the State's ongoing water quality management planning program.
4. Designation of all shipwrecks and artificial reefs as sanctuaries, with permissible uses described. Salvage of wrecks for commercial purposes could be prohibited.

5. Maintaining sand ridges and other important sport and commercial fishing areas in their present or enhanced state. This might be accomplished by prohibiting construction on sand ridges of such facilities as floating nuclear power plants, oil pipelines, offshore oil ports, or oil drilling platforms.

6. Development of recreational fishing facilities. This would include construction of artificial fishing reefs, ocean boat launching ramps, catwalks along bridges, and acquisition of oceanfront lands.

7. The state could designate a site as a marine sanctuary under the Federal Marine Sanctuaries Act of 1973, to protect a highly productive area from industrial development. Potential sites would be analyzed using criteria listed in the act. A possible site might be Shrewsbury Rocks, which is a unique New Jersey coastline feature. Another area for consideration is the submarine Hudson Canyon.

III. PHYSICAL CHARACTERISTICS AND IMPORTANCE

A. Inlets and Beaches

The twelve inlets found along the New Jersey Atlantic Ocean coastline are extremely valuable features. Inlets serve as access points for passage of both fish and human traffic between ocean and the estuarine waters. For the purposes of this report, Sandy Hook Bay, and the mouth of Delaware Bay will be considered inlets, as each is an access point to interior estuarine waters and tidal wetlands. The remaining ten inlets are: Shark River, Manasquan, Barnegat, Little Egg, Brigantine, Absecon, Great Egg Harbor, Corson's, Townsend's, Hereford, and Cold Spring (Cape May Canal).

Inlets are critical migratory pathways for numerous species of fishes. The young of many species of important sport and commercial fish use estuarine waters as nursery areas. Menhaden, bluefish, weakfish, fluke, and other species, spawn in the ocean. Their larvae swim and drift inshore through inlets into the estuaries for the summer growth period. There are at least 17 species of marine fish in New Jersey which are estuarine dependent, these are listed in Table 1. Summarized in Table 2 is harvest rank, and value of estuarine dependent fishes to sport and commercial fishermen in New Jersey.

Anadromous species such as striped bass, smelt, American shad, alewife, and blueback herring assend freshwater rivers and streams in order to spawn. After spawning is completed, the adults migrate through inlets back into the open ocean, until the cycle is repeated the following spring. Catadromous species such as the American eel must migrate from freshwater lakes, ponds, and rivers into the sea to complete their life cycle. These amazing creatures swim thousands of miles into the Sargasso Sea, north of Puerto Rico, where the adults spawn once and die. The eel larvae will eventually swim and drift northward with the Gulf Stream current into the bays and rivers to spend their adult lives. The mass migration of these young glass eels can be seen each spring assending freshwater rivers and streams. Dams are no barriers, as the glass eels have the ability to climb moist verticle walls.

In addition to acting a critical spawning pathways, the inlets are migratory pathways to feeding areas. Many forage fishes such as menhaden, striped and white mullet, summer in the estuaries and migrate south in the fall. Larger predatory species, which are actively sought by sport fishermen, congregate around inlets awaiting forage species movements or move directly into estuaries to feed.

Inlets are critical to estuarine water quality, allowing circulation and flushing of tidal areas. Inlets are the drainage route for all drainage basins which discharge into the Atlantic Ocean. Organic material (detritus) which has been synthesized in tidal marshes and upland vegetation, is an important nutrient in the coastal marine waters. Numerous species of phytoplankton, zooplankton, and shellfish utilize detritus, which acts as fertilizer for aquatic plants and directly consumed by invertebrates.

The value of coastal beaches requires little elaboration here. As a recreational resource, beaches are important to swimmers, sun bathers, beach combers, surf fishermen, picnickers, etc. These activities help support tourism, which is New Jersey's second leading industry, accounting for an estimated $2 billion annually.

Beaches also serve as habitat to the numerous gulls, terns and shore birds, which annually migrate along the coast. Natural barriers beaches are breeding habitat for colonial nesting littoral and wading birds which include: great blue and little blue herons, great and common egret, black and yellow-crowned night herons, glossy ibis, laughing and herring gulls, common and least terns, and American oyster catchers. These species have been documented to breed in New Jersey's coastal area.

In addition to acting as feeding areas and winter migratory stops for numerous upland bird species (Appelgate, 1974), barrier beaches are important habitat for endangered and threatened species; these include, osprey, bald eagle, peregrine falcon, marsh hawk, piping plover, ipswich sparrow, and yellow-crowned night herons. These species have been listed by the Department (New Jersey Register, 1975) as requiring special protection, or extinction in the State will follow.

Natural barrier beaches have been nearly eliminated from the New Jersey coastline, with the notable exceptions of those areas held by state or federal governments. This extensive development has seriously threatened vegetative species which form successional links in habitat development of sand dunes. Rare or endangered barrier beach plants in New Jersey include: seaside spurge, Japanese sedge, and sea-beach sandwort, according to Fairbrothers and Hough (1973). Beach plums, Prunus maritima, while not presently considered as an endangered species were formerly harvested by indians and white colonists, have been eliminated from much of their previous range in New Jersey. Some indian tribes waged wars to maintain harvest rights on Sandy Hook of these delicious fruit. The small white waxy bayberries have been harvested for use as a fragrance in candle making.

B. Submarine Rock Outcrops

There is only one submarine rock outcrop area found along the entire New Jersey coastline. This area is known as the Shrewsbury Rocks and is located off Monmouth Beach, in Monmouth County as shown in Figure 1. Much of this reef remains covered by sand with only scattered portions protruding through the sea floor. The 17 Fathom Bank, Cholera Bank, Southeast Ground, and the Stone Pile are part of this naturally occurring, horseshoe-shaped reef that extends from the Shrewsbury River in New Jersey to East Rockaway Inlet on Long Island, New York (Freeman and Walford, 1974). Only the Shrewsbury Rocks and 17 Fathom Bank are proximal to New Jersey.

Geologically this area is an extension of the inner coastal plain province. Monmouth County is the only area of direct contact between the inner coastal plain and the Atlantic Ocean. This rock outcrop is composed of consolidated clay marl deposits intermingled with glauconite. This rock is of alluvial origin and was probably formed by deposition river sediments.

The Shrewsbury Rocks is a congregation point for many species of sport fishes and is intensivly fished by sport fishermen. This prime fishing area is reached by both commercial party (head) boats from Atlantic Highlands and Highlands, New Jersey, by rounding Sandy Hook, and smaller private pleasure craft docking in the Navesink and Shrewsbury River or launching from Atlantic Highlands. Party boats from Shark River Inlet (Belmar) also utilize this area. Commercial party boats from Sheepshead Bay, New York also fish this area when fish are running and weather permits.

The list of species caught on the Shrewsbury Rocks is quite extensive. Many species are drawn to the area in order to feed on attached (fouling) marine organisms, this would include tautog (backfish), Atlantic cod, red hake (ling), scup, and black sea bass. The main value of hard substrates, whether natural or artificial, is to serve as suitable attachment sites for blue mussels, barnacles, boring clams, and tube-building worms. All hard substrates in the marine environment are quickly colonized by sissle organisms. The Shrewsbury Rocks also provide quality shelter areas for forage fishes from the high prized predatory species such as: bluefish, striped bass, bonito, fluke (summer flounder), and bluefin tuna. Most of the above species are migratory. Each season of the year will bring a change in the species composition, as one group moves out another moves in.

The Shrewsbury Rocks also serves as important habitat for the American lobster, which require shelter from their cannibalistic neighbors. This area helps contribute to the $300,000 (dockside value) worth of lobsters landed in Monmouth County in 1974 (NOAA, 1975). New Jersey ranks forth of the Mid-Atlantic States in lobstering. Many of the numerous sea food restaurants along the Jersey Shore operate their own lobster boats.

C. <u>Ship Wrecks and Artificial Fishing Reef</u>

Many ships and seamen have met their fate along the Jersey shore over the years. Over 300 vessels were wrecked along New Jersey and New York in the ten years from 1839-1849 alone. Figures 1 and 2 illustrate locations of wrecks and artificial reefs along the New Jersey coastline.

The numerous ship wrecks which remain are to this day extremely valuable physical marine resources. The number of shipwrecks greatly increased during World Wars I and II when allied and enemy vessels were sunk (Jensen, 1975). At least ten ships were torpedoed and sank within a mile of New Jersey's beaches during World War II alone (Freeman and Walford, 1974). Surplus warships and other vessels have been purposely sunk in prescribed sites for artificial fishing reefs since then.

Wrecks are excellent habitat for benthic (bottom dwelling) fishes. Stone (1974) reports that old ships and barges make excellent reefs because their high profiles induce upwellings and eddy currents that attract bait fishes and large predatory species.

Commercial operators of charter vessels and party boats have learned that concentrations of benthic fishes could be regularly found over sunken ships. Wreck fishing is the specialty of many New Jersey party boat captains who have equipped their vessels with sophisticated electronic equipment in order to locate wrecks consistantly, that might offer good fishing for their patrons.

Species frequently caught over wrecks include: Atlantic cod, pollock, red hake, tautog, black sea bass, and whiting. Recent wrecks which have a high profile appeal to Atlantic mackerel and bluefish.

In addition to surface sport fishing, wrecks are frequently visited by scuba divers. Divers seek American lobsters in the many crevasses or spear finfish. Other divers are more interested in artifacts such as portholes and other brass fixtures. Wrecks provide an interesting change from the nearly homogenous natural sand bottom, with only infrequent schools of passing fish.

Artificial fishing reefs are underwater structures designed to attract and concentrate fishes making them more available to anglers (Jensen, 1975). The concept of artificial reefs is not new. For centuries the Japanese have dumped rocks into local waters to increase fishing productivity (Zawacki, 1969). Locally, the first large-scale artificial fishing reef constructed in the Atlantic Ocean, was located about 10 miles southeast of Cape May Inlet. Construction was begun in the early 1930's by a group of Cape May and Wildwood sportfishing boat captains, in an attempt to improve fishing. The reef is still a favorite fishing spot (Freeman and Walford, 1974).

Seven artificial reefs have been constructed in the vicinity recently, five offshore Long Island and two offshore New Jersey, one is off Monmouth Beach and the other is off Sea Girt. A variety of substances have been used, some more suitable than others. Materials that have been used for construction of fishing reefs include: excavated rock, building rubble, scrap concrete pipes, old refrigerators and streetcars, junked automobiles and discarded automobile tires. Rock and rubble along with ballasted automobile tires are among the best sources of material for reef construction. Junked automobiles, of which there is an abundant supply, would at first seem to be an ideal way to dispose of abandoned autos, but there are a number of drawbacks. First, being mostly iron, sea water rapidly rusts bodies away so that car reefs last only three to six years, which may be too short to establish a viable habitat. Secondly, extensive preparations must be completed before sinking, such as draining of fuel and lubricating oils and removal of upholstery. Solid wastes might be disposed of in a beneficial way, by compaction, blasting, and ocean disposal into artificial reefs. Concrete, rock, and blasted auto tires are presently the most feasible materials.

Table 3 shows that catches of bottom fishing was more successful over artificial reefs and wrecks than natural bottoms. Jansen (1975) states that there is no question that artificial fishing reefs work. Reefs can be a valuable fisheries management tool and offer one way of attracting and congregating fish in a given area by supplying shelter and food.

D. Jetties

The numerous rock groins found along New Jersey's Atlantic coastline are called jetties by most local residents. These were constructed for the purpose of preventing beach erosion and reducing the force of storm waves. Whether they have succeeded or failed in this goal is a matter of debate. In Monmouth County, where at least 150 jetties have been built perpendicular to the shoreline, sand has, in fact, built up on the south side, carried by the northern littoral drift. This may, however have been, at the expense of the beach area directly south. Jetties have succeeded in an unintended way by providing valuable finfish and marine wildlife habitat and serve excellent fishing platforms.

These structures serve as suitable attachment sites for sissle life forms and shelter areas to many species of marine organism. Jetties support resident population of attached algae, crustaceans, and mollucas, which in turn attract territorial fish and predatory species in a similar manner to wrecks and artificial reefs, previously discussed. The jetties of New Jersey are heavily fished by local resident and tourist fishermen.

Jetties also help support marine birds and migratory waterfowl. Herring gulls and great black-back gulls are frequently seen resting on jetties, watching for food. Gulls also utilize jetties in another more ingenious way, almost like a tool. Gulls can be frequently seen during the winter months, when migratory fishes have left the area, feeding on permanent resident invertebrates. Surf clams, hard clams, moon snails and crustaceans, which gulls are otherwise unable to open, are carried aloft and dropped on the hard rocks. After the shell bursts open, the bird must quickly scoop up this prize, before it is stolen by another gull. Most jetties of New Jersey are heavily colonized by the edible blue mussel (a unutilized food resource). Blue mussels constitute a major food of the numerous diving ducks which winter annually in New Jersey. These include: greater and lesser scaup (broadbills), old squaw, and the white-winged, common, and surf scoters.

E. Sand Ridges and Basins (Fishing Grounds)

The portion of the Atlantic Ocean off New Jersey known as the New York Bight has been described as having a rigorous hydraulic climate. Storm track tend to pass northward into the Bight and may pause there (Swift et al., 1975). Intense northeast winds blow down the entire arc of the Bight. These conditions have resulted in a strong coupling between wind and water flow, so that the shelf water column may move uniformly southward in a slab-like fashion for a period up to several days. Transportation of huge quantities of sand on the shelf occurs during intense bursts, when storm accelerate near bottom flow above a threshold of 20 cm/sec (Swift *et al*, 1975).

The most striking response of the sea floor to storm flows is the ridge and swale topography. Sand ridges up to 10 meters high, 2-4 kilometer apart, with side slopes less than a degree are common offshore New Jersey. Ridge crests extend for many miles offshore, converging to the south with the shoreline at angles of 15° to 35°. The underwater morphologic framework of New Jersey's offshore waters is illustrated in Figure 3.

The sand ridges which are separated by well scoured fine clay-lined sediment depressions appear to be a long term, time-average response to prevailing currents, storm surge and a retreating shoreline. Sand ridges on the central New Jersey shelf yield successily older dates with depth (Swift et al., 1975). Ridges appear to form at the foot of shoreface. There is evidence that nearshore ridges migrate very slowly offshore and southward, extending their crestlines to maintain contact with the retreating shoreline. Ridge positions shift only slowly in time.

The value of sand ridges is as a finfish habitat. The various fishing grounds adjacent to the New York metropolitan area are among the most intensively fished in the world (Freeman and Walford, 1974). The Manasquan and Barnegat Ridges are favorite fishing areas for sport bluefish and tuna fishermen. Other important sand ridge fishing grounds are: Long Branch Grounds, England Bank, Klondike, Brigantine Shoal, Atlantic City Ridge, The Fingers, Five Fathom Bank, the Lumps, and Old Grounds. The location of these are dipicted in Figure 4.

The various ocean basins, depressions, and deeper swales are excellent habitat for shellfish and demersal fishes. Sea scallops and American lobsters, along with surf clams are the most important shellfish harvested in the depressions. Important ocean basins found in New Jersey coastal waters include: the Mud Hole (Hudson Channel), Lobster Hole, 27 Fathom Hole, and Lummis Slough. These are also located in Figure 4, and like the ridges are important fishing grounds.

F. Submarine Canyons

The submarine canyons found offshore New Jersey were formed during glacial periods by erosion of surface rivers. The Hudson, Wilmington, and Baltimore Canyons are major canyons found in offshore New Jersey waters. Submarine canyons are important migratory pathways and wintering areas for large oceanic fishes. Canyons are also valuable lobster fishing areas.

Sportfishing in submarine canyons has increased in popularity since the beginning of the 1960's. Encouraged by reports of commercial fishermen seeing large numbers of tuna and billfish near the heads of offshore canyons, sport fishermen began fishing these areas, even though it required a 200 mile round trip. Catches were made of swordfish, giant bluefin tuna, white marlin, yellow fin tuna, albacore, wahoo, and blue marlin. Tilefish of up to 50 pounds are taken along the bottom (Freeman and Walford, 1974). Within the last few years, both charter and party boats have sailed to Hudson, Wilmington, and Baltimore Canyons seeking marlins, tunas, and tilefish.

IV. ANALYSIS

Multiple pressures presently and potentially affect the viability and utilization of physical marine resources. These include the following:

A. Water Quality Degradation

Ocean dumping of domestic (sewage sludge) and industrial wastes, degrades water quality contaminate sediments. The recent massive finfish, surf clam, and lobster kill offshore New Jersey during the summer of 1976 brought to public attention the possible harmful effects of ocean disposal of sewage in the "Dead Sea" area. The exact causes of this extensive kill have been determined to have resulted from an explosive bloom of the dinoflagellate phytoplankton *Ceratium* in the thermocline. Death of these plants followed by bacterial decay, resulted in removal of dissolved oxygen from the water and suffocation of benthic species (Paulson, 1976). The stimulating factors causing this bloom, are probably a combination of excess nutrification of water through ocean waste disposal and urban runoff, coupled with reduced water column mixing and successive sunny days.

B. Energy Developments

Energy developments in offshore and nearshore waters from OCS oil and gas and proposed floating nuclear power plants propose potential impacts on physical ocean resources. Drilling platforms may be sited on critical fish or shellfish habitat. Pipelines may be routed through important shellfish habitat areas. Oil spills always are a potential threat to inlets, beaches, and jetties.

The proposed floating nuclear power plant is sited less than 3 miles off Little Egg Harbor Inlet on a prominent sand ridge. Benthic life inhabiting this ridge will be destroyed through construction of breakwater. The thermal plume will be discharged directly into the mouth of this important inlet. The potential environmental impacts from this plant are being grossly underestimated. Massive mortalities of planktonic life including ichthyoplankton (fish eggs) and adult fish will surely be incured through intake of cooling water. If a major accident occurs, such as blockage of cooling waters through impingment of tight schooling menhaden on intake screens for example, the reactor core will melt causing leakage of radioactive materials into the ocean. These radioactive materials will be carried south onto New Jersey's most important surf clam areas. Important public beaches south of Atlantic City will likewise be contaminated. Radioactive substances will be incorporated into the sediments and contamination of the marine food chain will certainly follow.

Offshore oil ports are another potential use of New Jersey's marine environment. These like floating nuclear plants are a new technology. Potential impacts of offshore oil ports are accidental oil spills and onshore development along pipeline routes. Impacts of oil spills on the natural environment are discussed in a separate issue paper entitled Ocean Resources: Mineral.

C. Public Access

Public access to beaches and jetties is a problem presently under consideration by this Department. The "wet sands", those flowed by the tides, are public lands held in trust by the state. These areas must be open to the public and not limited to town residents or private members. Surf fishermen, which number in the hundreds of thousands in New Jersey, are constantly facing the problem of how to reach an area where fish are present. It must be remembered that local residents and seasonal visitors, who utilize marine resources, also help support local economies. Numerous developments (private beach clubs and beach houses, highrise condominiums) activity seek to prevent access to "their" beach by fences and posting signs.

Table I - Important Estuarine Dependent Fishes of New Jersey

Common Name	Spawning Area	Use of Estuaries: Spawn	Nursery Area	Migration Route	Adult Feeding	Wintering	Behavior and Ecological Value
Alewife	Freshwater ponds	-	x	x	x	-	Anadromous, forage fish, particulate feeder
Blueback herring	Fresh tidal water	-	x	x	x	-	" "
Bluefish	Outer shelf ocean	-	x	x	x	-	Marine migrant marine and estuarine piscivor
Croaker	Coastal ocean	-	x	x	x	x	Coastal species, demersal, omnivorous
Black Drum	Estuaries	x	x	x	x	-	Benthic shellfish feeder
American eel	Sargasso Sea	-	x	x	x	x	Catadromous, piscivor
Summer flounder	Mid-shelf ocean	-	x	x	x	-	Marine migrant demersal, piscivorous
Winter flounder	Brackish rivers, bays	x	x	x	x	x	Winter resident, demersal, omnivorous

Table I - Important Estuarine Dependent Fishes of New Jersey (Continued)

Common Name	Spawning Area	Spawn	Nursery Area	Migration Route	Adult Feeding	Wintering	Behavior and Ecological Value
		Use of Estuaries					
Menhaden	Coastal ocean	-	x	x	x	-	Forage fish, planktonic filter feeder
Mummichog (killie-fish)	Tidal rivers, bays	x	x	-	x	x	Estuarine resident, omnivorous, forage fish
White mullet	Mid-shelf ocean	-	x	x	x	-	Forage fish, herbivorous, migratory
White Perch	Fresh tidal waters	x	x	-	x	x	Estuarine resident omnivorous
American Shad	Large fresh-water rivers (Delaware & Hudson River)	-	x	x	x	-	Anadromous, forage fish, particulate & plankton feeder
Silverside	Estuaries	x	x	-	x	x	Forage fish, feeds on small arthropods
Striped Bass	Fresh tidal rivers	-	x	x	x	x	Anadromous, omnivorous, migratory

Table I - Important Estuarine Dependent Fishes of New Jersey (Continued)

Common Name	Spawning Area	Use of Estuaries: Spawn	Nursery Area	Migration Route	Adult Feeding	Wintering	Behavior and Ecological Value
Scup (porgy)	Estuaries, bays, coastal ocean	x	x	x	x	-	Benthic omnivorous
Spot	Coastal ocean	-	x	x	x	-	Estuarine resident, benthic omnivor
Weakfish	Bay mouths	x	x	x	x	-	Marine and estuarine piscivor
Bay Anchovy	Estuaries	x	x	x	x	-	Forage fish, filter feeder

References: (Breeder, 1948; BLM, 1976; Douglas and Stroud, 1971; Thomas, 1971)

Table 2 - Harvest of Important Estuarine Dependent Fishes of New Jersey

	Sport Fishing[1] (1970)			Commercial Fishing[2] (1974)		
Common Name	Rank by Weight	Number	Estimated Weight (lbs)	Rank by Weight	Weight (lbs)	Land Value (dollars)
Alewife & Blueback Herring	-	----	----	12	10,600	$ 424
Bluefish	1	12,351,000	49,720,000	5	1,003,115	115,100
Croaker	7	4,617,000	3,831,000	10	45,180	6,470
Black Drum	8	26,000	1,454,000	11	33,317	3,095
American Eel	7	367,000	740,000	6	216,214	75,586
Summer Flounder (fluke)	8	4,191,000	7,742,000	2	3,499,419	1,153,421
Winter Flounder	5	7,496,000	12,881,000	8	140,242	17,136
Menhaden	-	----	----	1	107,307,501	2,734,831
White Perch	6	15,072,000	12,592,000	9	102,011	23,123
American Shad	5	1,541,000	4,231,000	7	121,558	26,144
Striped Bass	2	9,857,000	27,262,000	5	713,616	177,203
Scaup (porgy)	6	1,188,000	2,127,000	3	6,039,977	879,679
Spot	3	32,952,000	21,573,000	13	10,522	1,438
Sturgeon	-	----	----	14	9,972	1,965
Weakfish	4	9,397,000	14,039,000	4	2,686,175	312,221

Sources:

1. 1970 Salt-water Angling Survey (Deuel, 1973). Sport Harvests are for Mid-Atlantic States: New Jersey to Cape Hatteras, N.C.
2. New Jersey Landings - Annual Summary 1974 (NOAA, 1975)

Table 3 Bottom fishing by anglers in northwest section of the Bight, 1970

Habitat Type	Angler Hours	Number of fish Caught	Catch/Hour
		Private Boats	
Natural bottom	3,386	4,916	1.5
Artificial reefs	252	357	1.4
Wrecks	144	333	2.3
		Headboats	
Natural bottom	87,026	128,631	1.5
Artificial reefs	2,751	8,249	3.0
Wrecks	10,516	32,368	3.1

SOURCE: Jensen (1975)

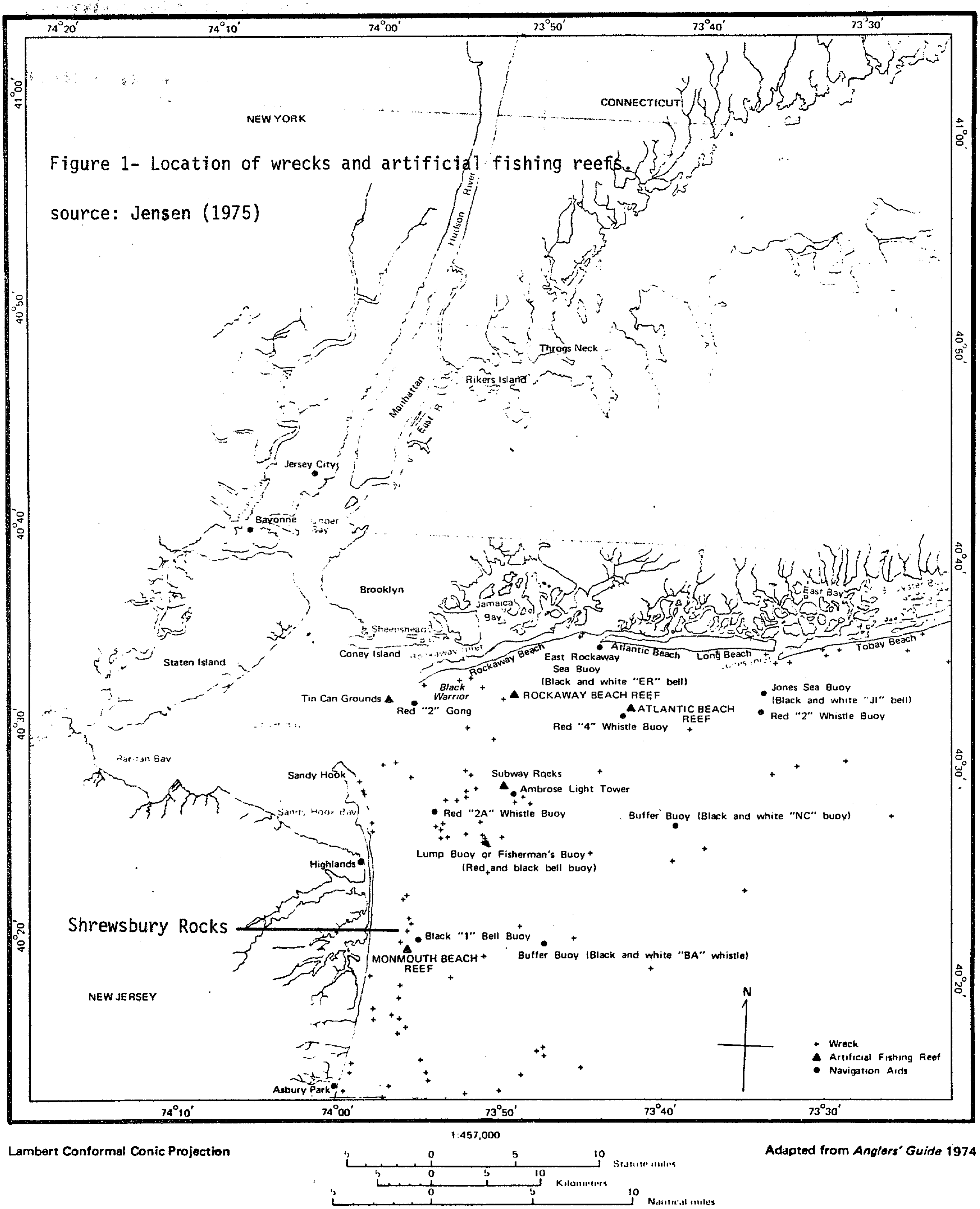


Figure 1- Location of wrecks and artificial fishing reefs.

source: Jensen (1975)

Lambert Conformal Conic Projection

Adapted from *Anglers' Guide* 1974

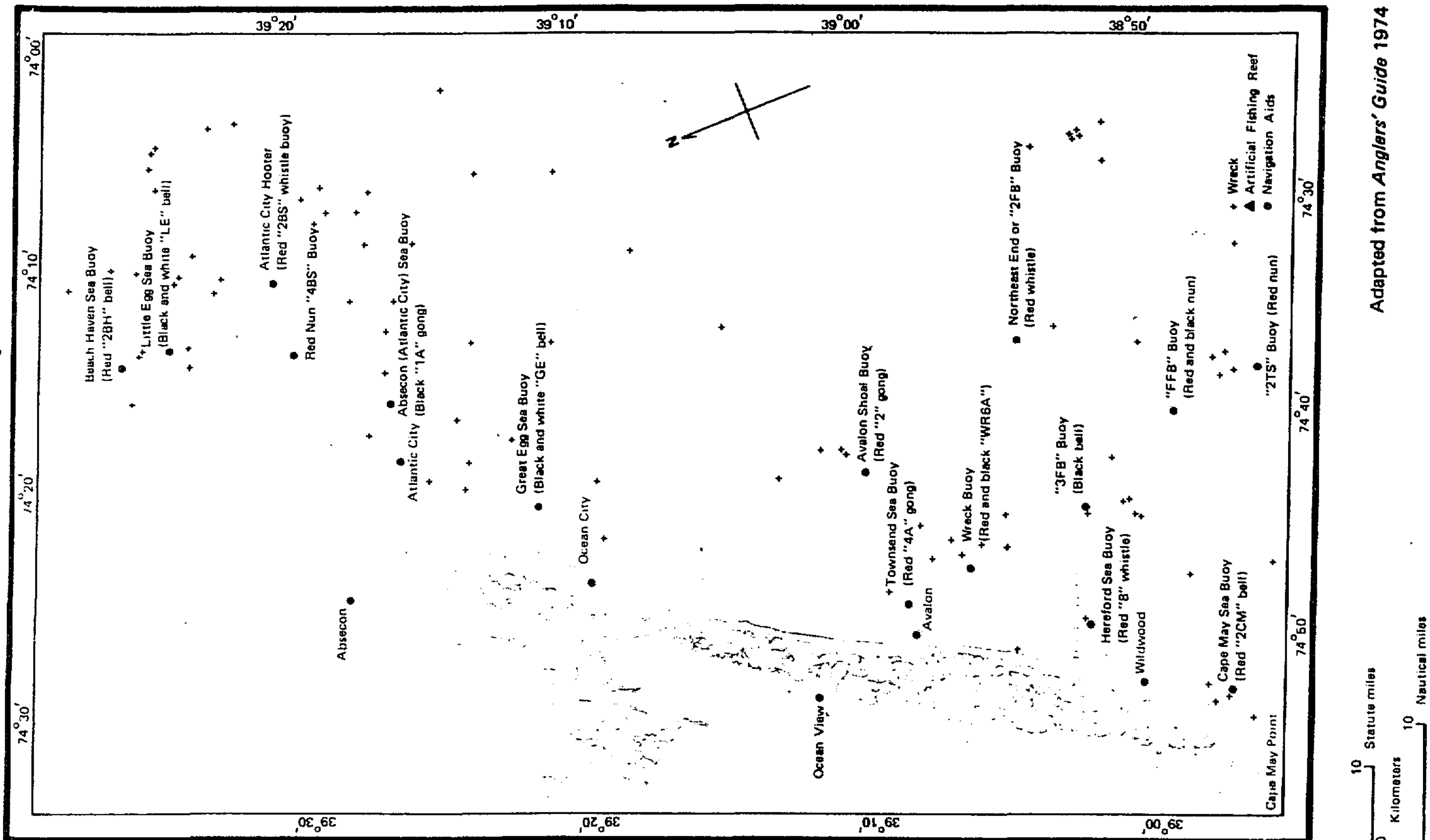
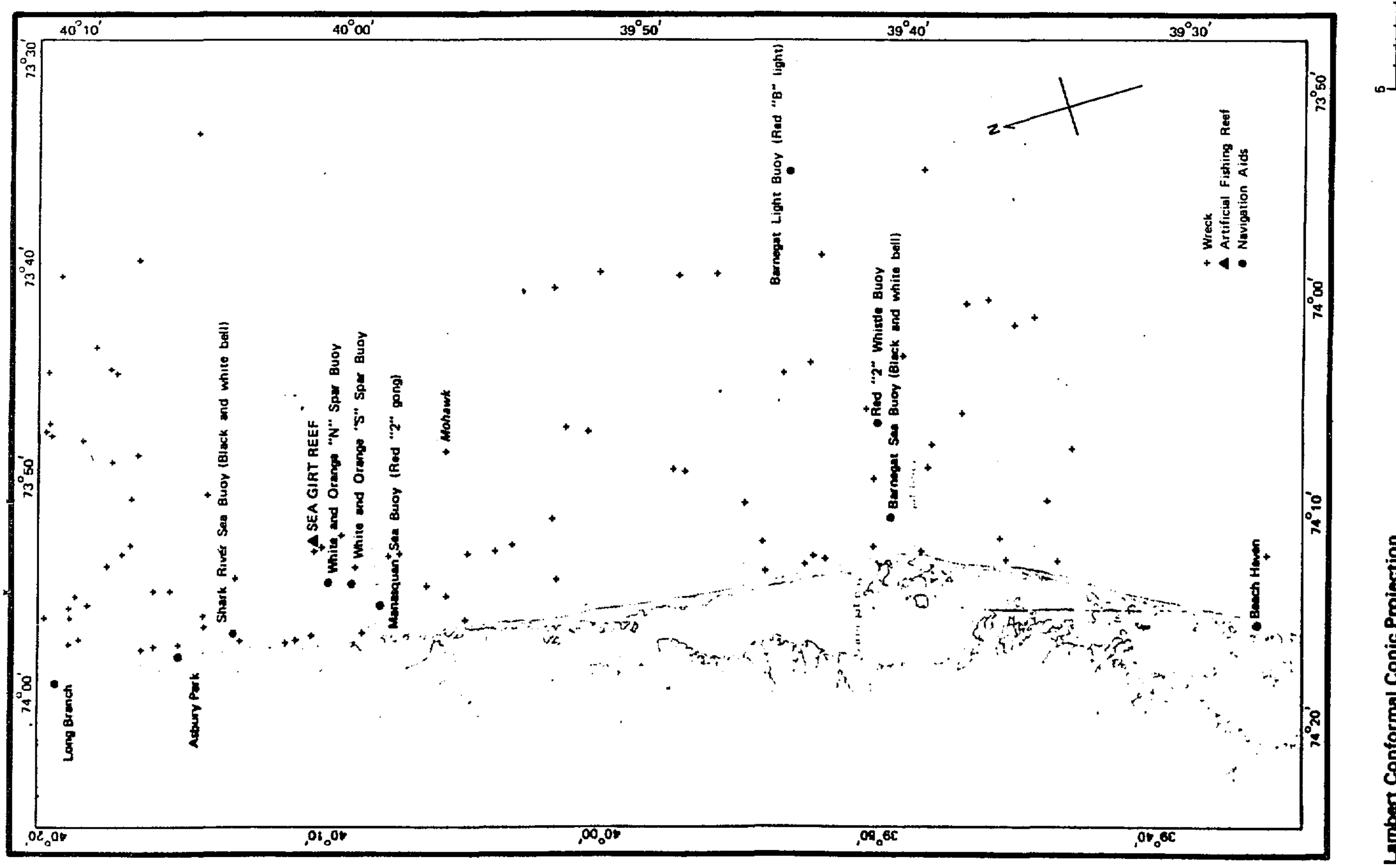


Figure 2.- Locations of wrecks and artificial fishing reefs.

source: Jensen (1975)



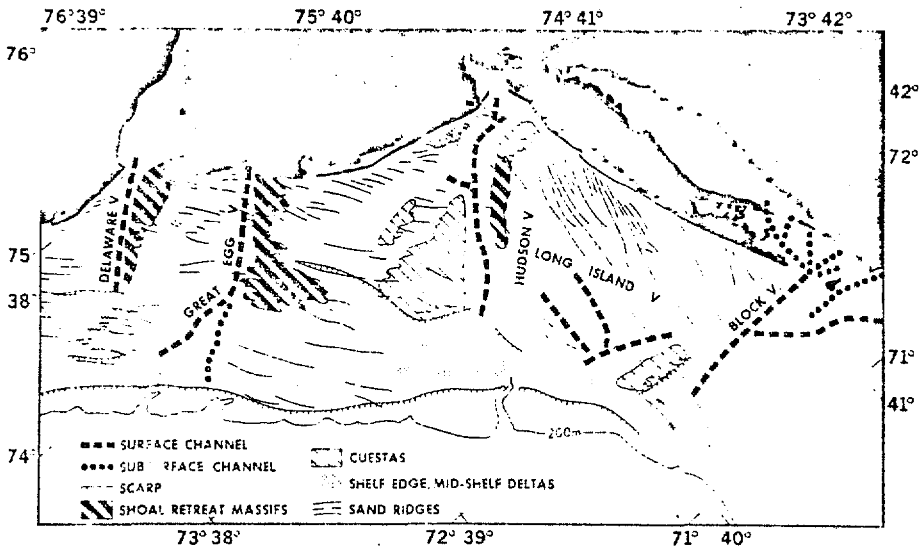


Figure 3.- Morphologic framework of the New York shelf surface.

source: Swift et al. (1975)

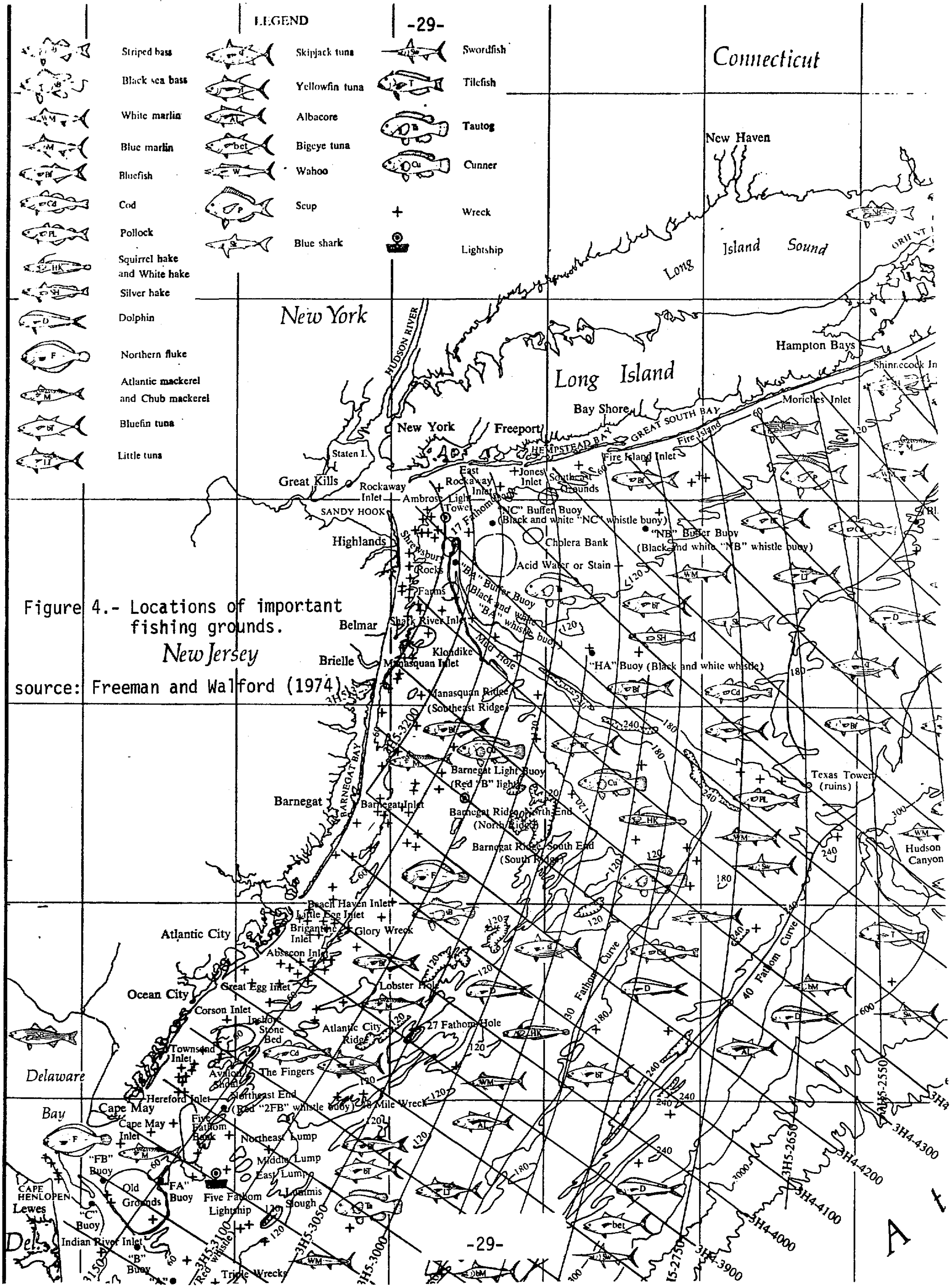


Figure 4.- Locations of important fishing grounds.

source: Freeman and Walford (1974)

APPENDIX B

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